SECRET

25X1

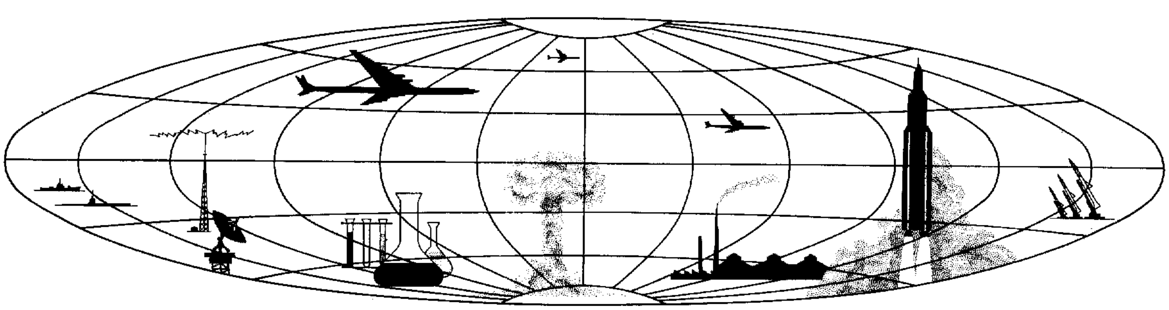
NPIC/R-1004/61
November 1961

PHOTOGRAPHIC INTERPRETATION REPORT

PHOTOGRAPHIC STUDY OF HEN ROOST
ANTIMISSILE TEST CENTER
SARY SHAGAN, USSR

ARMY [redacted]VY AIR FORCE CIA

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER



25X1

Approved For Release 2004/05/12 : CIA-RDP78B04560A000100010009-5
SECRET

WARNING

This material contains information affecting the National Defense of the United States within the meaning of the espionage laws, Title 18, USC, Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

PHOTOGRAPHIC INTERPRETATION REPORT

PHOTOGRAPHIC STUDY OF HEN ROOST

ANTIMISSILE TEST CENTER

SARY SHAGAN, USSR

NPIC/R-1004/61

November 1961

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER [redacted] 25X1

PREFACE

This report presents a detailed photographic study of HEN ROOST (500-foot antenna) at the Antimissile Test Center, Sary Shagan, USSR, in response to CIA requirements OSI/R-1/61 and OSI/R-33/61 [redacted] 25X1 Although the exact antenna configuration 25X1 cannot be defined, the report objectively describes those components which can be positively identified and sets forth the most probable configurations of other antenna components. The appendix gives brief descriptions of an antenna near Krasnovodsk and of the Mills cross at Serpukhov, both of which show specific component similarities to HEN ROOST.

SUMMARY

The HEN ROOST antenna system appears at two sites at the Sary Shagan Antimissile Test Center. The northern site consists of a 500-foot reflector screen, an elevated feed structure, and a clutter screen, in addition to microwave antennas, a control building, and support structures.

The reflector screen is fixed and heavily back-braced. It consists of a cut-section cylindrical paraboloid with the addition of (1) reinforcing at the top, or (2) a top-mounted rectangular plane screen, or (3) a more sharply curved section at the top (giving a double-curved screen). The angular curvature, and likewise the focal point, cannot be measured.

The tower-mounted feed has heavy horizontal bracing with a segmented curved feed reflector screen. The feed elements are not visible. Either the feed structure, or the feed reflector, or the combined structure and reflector may have declination motion. The feed reflector segments are either cut-section cylindrical paraboloids or double-curved.

The 620-foot-long clutter screen is positioned 300 feet in front of the reflector and extends beyond the northern end of the reflector.

The two HEN ROOST antennas are 3,500 feet apart, offset 550 feet, and have a major radiation orientation [redacted] 25X1D

[redacted]

USSR

25X1

25X1

SECRET

SECRET

29739 3-61

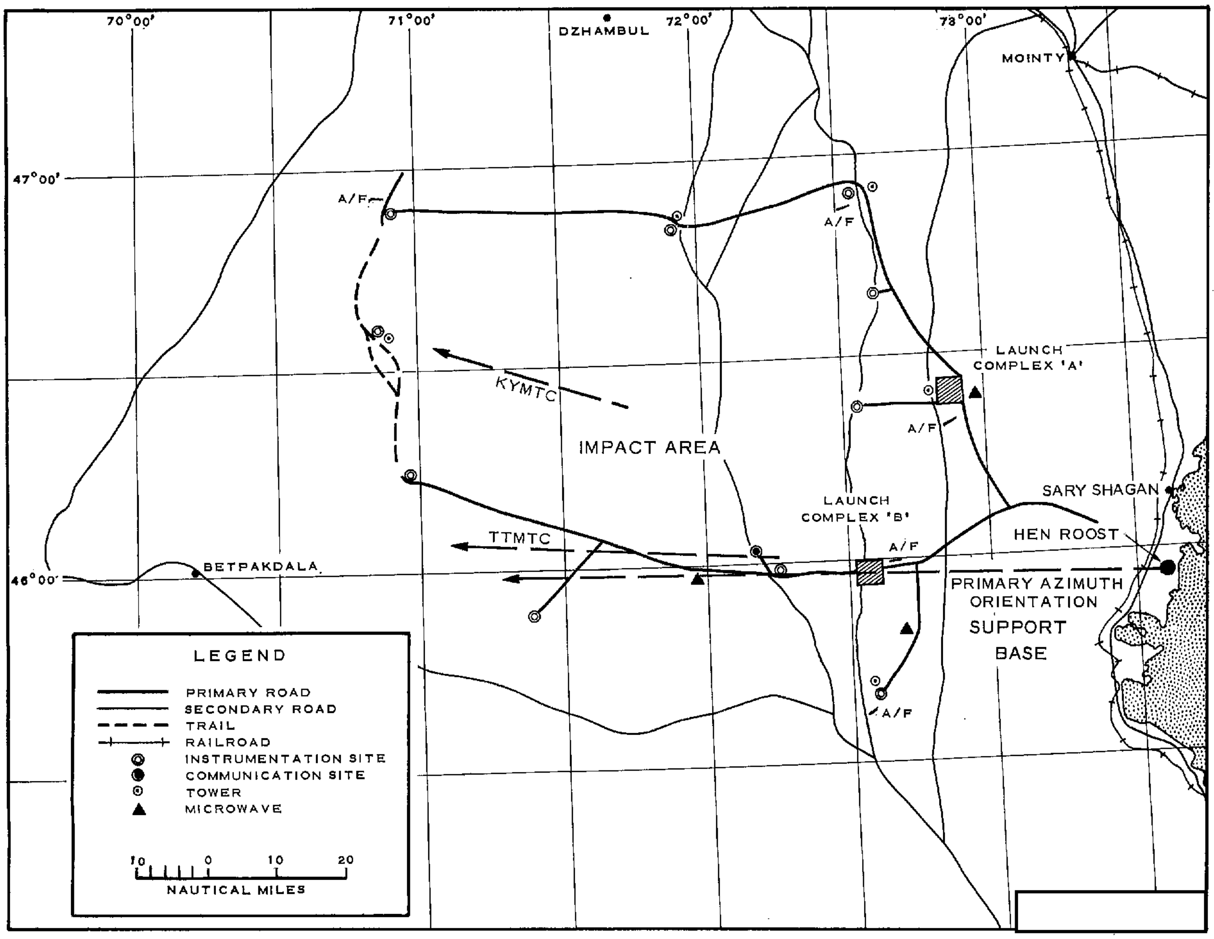
FIGURE 1. LOCATION MAP.

NPIC/R-1004/61

25X1

INTRODUCTION

The HEN ROOST antenna system at the Sary Shagan Antimissile Test Center (Figure 1) was analyzed from photography [redacted] This analysis was hampered by more than 90 percent cloud cover over one site (the southernmost) and by partial cloud cover over the other site, in addition to unfavorable sun and photographic angles which necessitated deriving most antenna component configurations from ground shadows. This northernmost site, located at 45-56N 73-38E (Figure 2), is referred to as Radar Site 1 in CIA/PIC/JR-1010/61. 1/ However, further study of the photography indicates that the implication of the word "radar" 25X1D



[redacted] 25X1

FIGURE 2. LOCATION OF HEN ROOST, SARY SHAGAN ANTIMISSILE TEST CENTER.

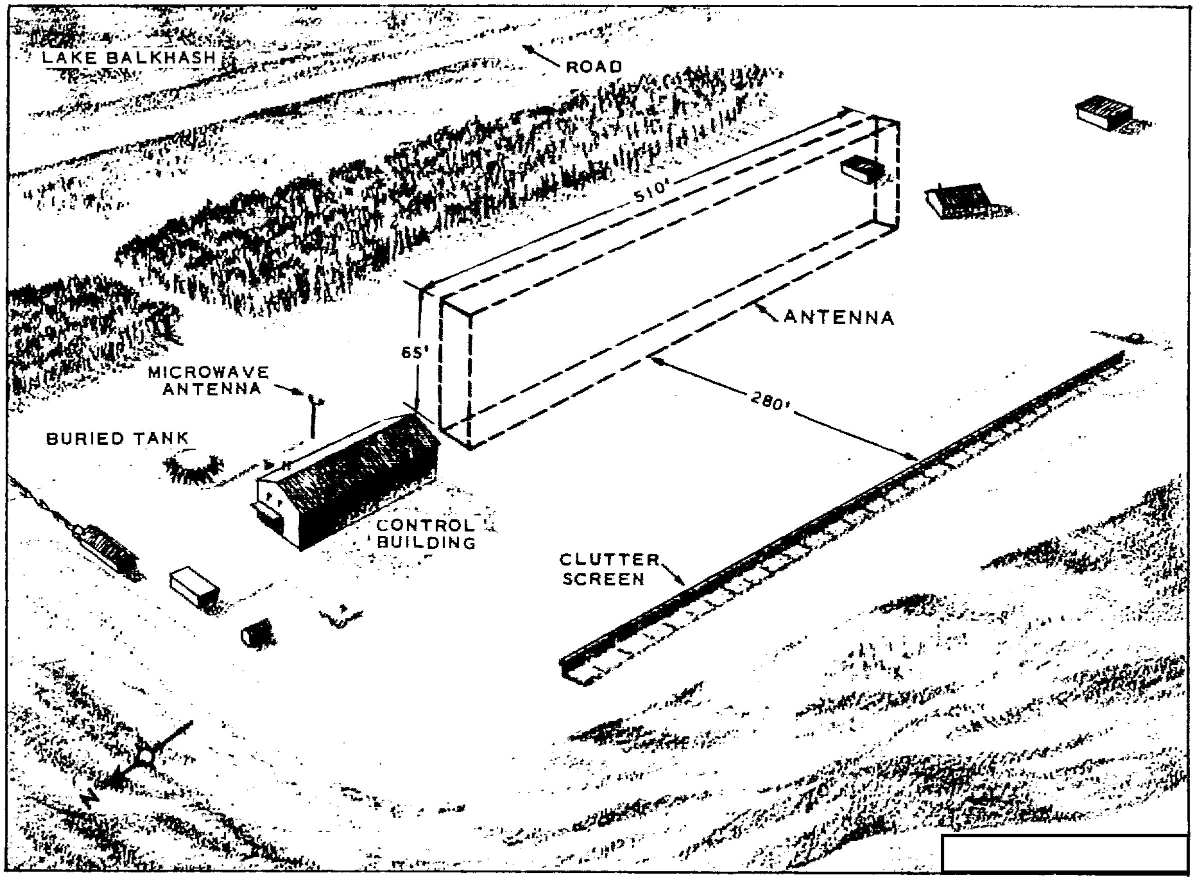


FIGURE 3. HEN ROOST (NORTHERN SITE), SARY SHAGAN ANTIMISSILE TEST CENTER.

is not specifically evident. Figure 3 is a perspective drawing of the site showing the location of operational and support facilities and the relationship between them. The site is served by an all-weather road from the Support Base, but no tie-in with the power grid can be identified. A water line leads from the site to Lake Balkhash. Adjacent to the antenna is a multistory building which may house computer equipment and is probably the main control facility at the site.

HEN ROOST ANTENNA ANALYSIS

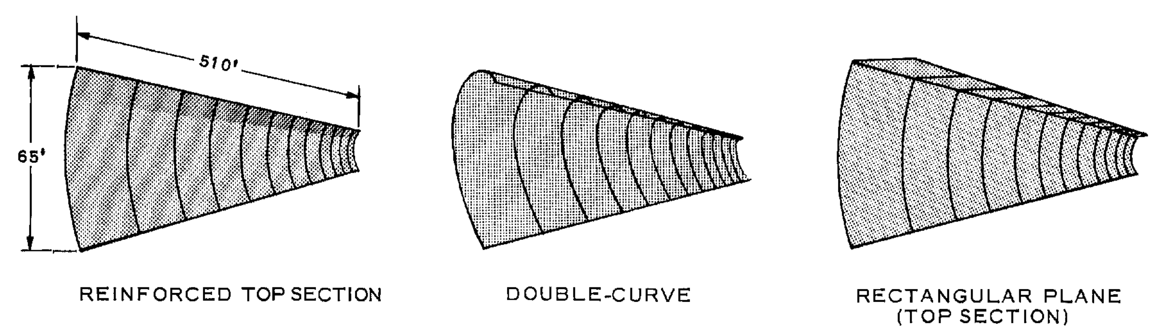
The northern HEN ROOST site is the only one which could be studied in detail. Only a few antenna construction details are identifiable from the structure [redacted]

The definitive antenna components consist of a fixed reflector screen, an elevated feed structure, and a clutter screen. Reflector mesh size, focal point, angle of inclination, and feed-element configuration could not be determined from the photography. [redacted] 25X1D
[redacted] The antenna appeared 25X1D
to be capable of operational status at the time of the photography.

Fixed Reflector Screen

The fixed reflector screen is basically a cut-section cylindrical paraboloid with its axis tangent to the earth's surface. Overall dimensions are 510 feet in length (horizontal) and 65 feet in chord (vertical), giving an area greater than 33,150 square feet (3,079.5 square meters). There are 13 main vertical ribs (including end ribs) following the curvature of the screen which appear to divide the reflector into 12 equal [redacted] 25X1D
[redacted] segments. Each vertical rib has a slanted back brace running to a 25X1
large concrete footing. Each back brace appears to have secondary side braces affixed to the reflector.

A detailed study of the reflector shadow indicates that there is something along the entire top section of the reflector. This may be additional bracing from stiffening or else an alteration (not measurable) of screen curvature (Figure 4). If an alteration, it could be a rectangular plane screen



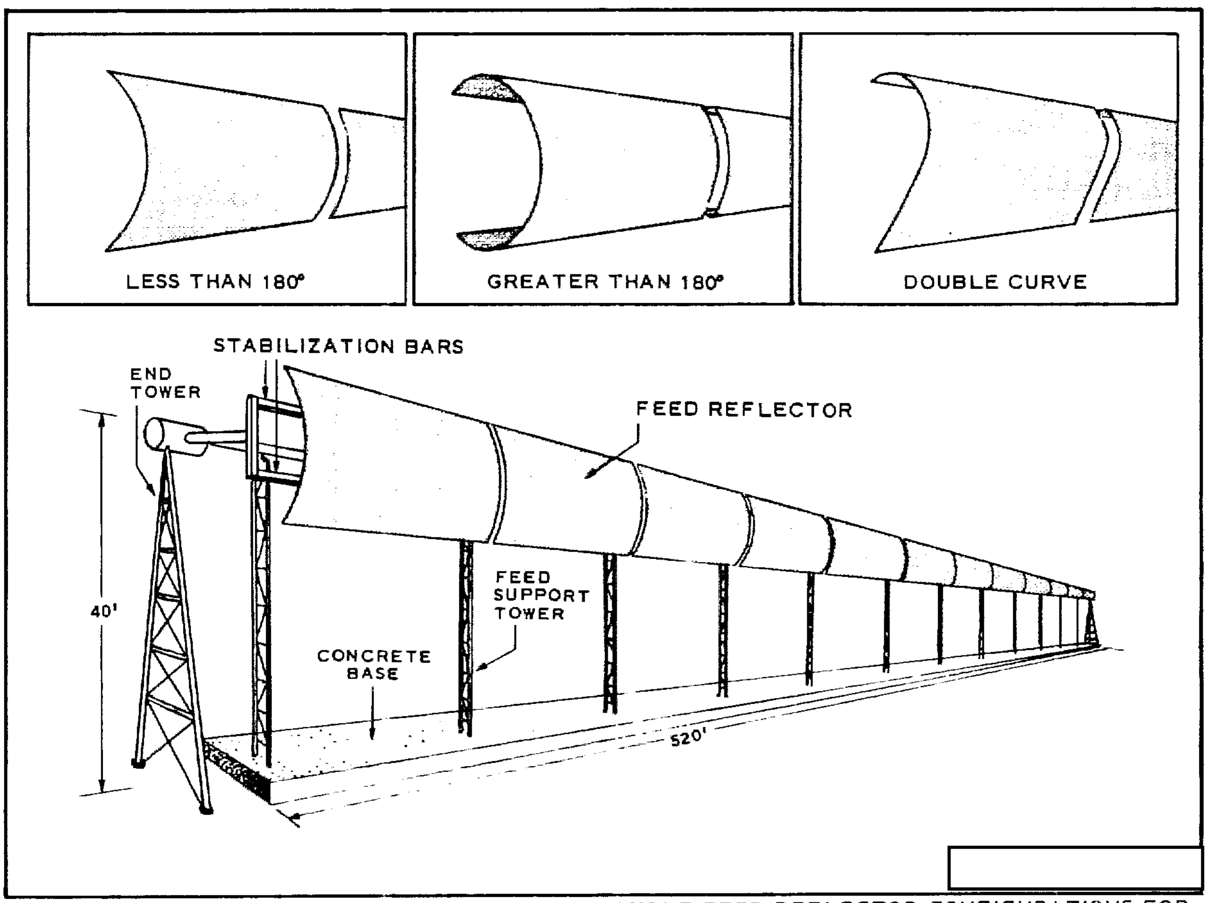
[redacted] 25X1

FIGURE 4. POSSIBLE REFLECTOR-SCREEN CONFIGURATIONS OF HEN ROOST.

or a sharply curved section (giving a double-curved reflector). The first alteration (rectangular plane screen) combined with the main reflector screen is similar in design to the antenna near Krasnovodsk (Figure 6).

Elevated Feed Structure

The elevated feed structure is in front of and parallel to the fixed reflector screen. The structure consists of a concrete base, 13 support towers, 2 end towers, 2 horizontal feed-element stabilization bars, and 12 segmented feed reflectors (Figure 5). These components have similarities to components of both the antenna near Krasnovodsk and the Mills cross near Serpukhov (see Appendix).



25X1

FIGURE 5. FEED SUPPORT COMPONENTS AND POSSIBLE FEED-REFLECTOR CONFIGURATIONS FOR HEN ROOST.

Concrete Base

The concrete base, measuring 520 by 35 feet and 5 feet high, is utilized as a footing for the 13 support towers. However, the height of this base, along with the fact that it extends between the support towers, appears to negate its utilization as only a footing. Beneath the support towers of the east-west leg of the Mills cross these are subterranean concrete chambers housing preamplifiers, transmission-line junctions, and phase-adjustment points. The concrete base for HEN ROOST may have a similar function, since no aboveground transmission/feed lines are visible.

Support Towers

The 13 support towers are bipods approximately 35 feet in height. The tower footings are transverse to the feed structure and have no apparent lateral support. The towers are equally spaced at [redacted] intervals -- the same spacing as for the vertical ribs in the reflector screen. The antenna support towers on the east-west arm of the Mills cross at Serpukhov (Figure 7) appear similar to the feed support towers at HEN ROOST. Support tower similarities at the two locations can be seen from the following data. 25X1D

Antenna	No of Footings per tower	Tower Design	Tower Height (ft)	Tower Spacing (ft)	Static Loading
Mills cross	2	Heavy verticals, light horizontals, & crossed diagonals	65	[redacted]	Light
HEN ROOST	2	Same	35		Heavy

25X1D

The feed support towers for the Mills cross antenna are designed for a light dynamic loading. Although no declination motion was observed for the HEN ROOST feed, the feed support towers have an inherent design capable of sustaining such a motion.

End Towers

The two end towers are bipods approximately 40 feet in height. They are on separate footings (not attached to the concrete base), and each is [redacted] from the nearest feed support tower. The top of each end tower is on the same plane as the top of the feed support towers. Each end tower has a top-mounted unidentified cylindrical object whose central axis is aligned with the feed support towers. The end tower for the Mills cross antenna is a tripod, but otherwise is similar to the HEN ROOST end towers.

25X1D

Horizontal Feed-Element Stabilization Bars

The two horizontal feed-element stabilization bars (upper and lower) are 510 feet in length, with an undetermined separation. These bars are plane parallel, with the upper bar being in a vertical or near vertical reference to the lower bar. The bars extend between the end towers and, from shadow analysis, appear massive. Between the end towers and the bars, an indistinguishable type of connecting link is visible. The basic structure formed by the bars appears similar to the feed structure for the antenna near Krasnovodsk.

Segmented Feed Reflectors

The 12 segmented feed reflectors appear to be basically cut-section cylindrical paraboloids, mounted on the forward side of the feed structure, and measuring approximately 40 feet in axial length. The axis of these reflectors is parallel to the feed structure. Three possible configurations for these reflectors, determined through shadow analysis, are: (1) an arc with an angle less than 180°, (2) an arc with an angle greater than 180°, and (3) a double-curved configuration (Figure 4). The mesh size cannot be determined.

Clutter Screen

The clutter screen (Figure 3) is parallel to and 280 feet in front of the concrete base of the feed structure. The screen is 620 feet long and [redacted] high and slopes away from the antenna. It runs the full length 25X1D of the antenna and extends 110 feet beyond to the north. The ground appears to have been leveled for its construction. The clutter screen for the Krasnovodsk antenna is about the same length and distance out from the antenna.

• • •

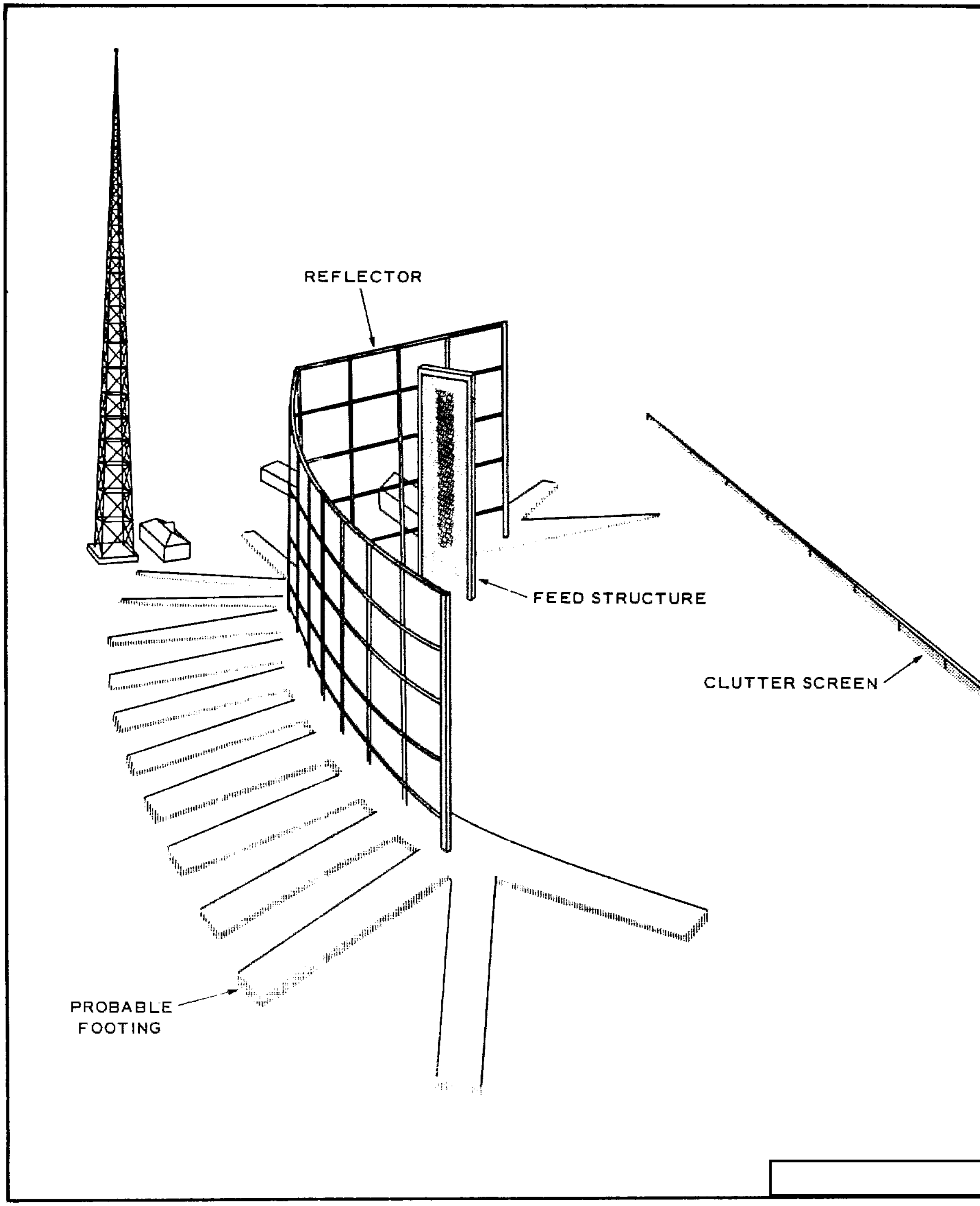
APPENDIX

Antenna Near Krasnovodsk, USSR

This antenna, covered by [redacted] photography, is located at 25X1D 40-02N 52-57E, 3 nm northwest of Krasnovodsk, USSR. The antenna, a large mattress type, is within a fenced area measuring 915 by 615 feet, situated on relatively high ground (Figure 6). The area also contains a feed mast, control building, and clutter screen.

The mattress antenna consists of an upended cut-section, half-cylindrical paraboloid and a plane section at one end at a 105° angle. The cut section measures [redacted] high and the plane section, 125 by 115 feet high. Both sections have equally spaced horizontal and 25X1D vertical ribs.

The feed mast, measuring 30 by 110 feet high, is adjacent to the plane section at a point approximately 70 feet from the junction of the two sections. The feed mast may have a capability of rotation on its vertical



25X1

FIGURE 6. ANTENNA NEAR KRASNOVODSK, USSR.

A traditional Mills cross consists of two long, narrow, horizontal antenna arrays, generally set perpendicular to one another in a symmetrical pattern. Each arm of the cross produces a fan-shaped beam. Electronic "multiplication" of one beam by the other permits rejecting all signals except those arriving from the direction common to both, producing in effect a single pencil-shaped beam. The conventional plan is to have one arm extend from east to west so that its fan beam lies in the meridian plane. The other arm (north-south) then produces a fan intersecting the celestial sphere in the prime vertical plane. However, if the electrical phases of the individual elements in this arm are staggered progressively, its great circle will be inclined either to the north or south of the prime vertical. Thus, the resultant pencil beam can be moved north or south in the meridian plane by phase adjustment of the north-south elements. The principal advantage of a Mills cross is that it gives very high resolving power at relatively low cost.

The Serpukhov cross has arms one kilometer long and is intended for use in the meter range of wave lengths. At a frequency of 100 megacycles per second, it can be expected to have in the zenith a beam of circular cross section with a half-power beam-width of 10 or 12 minutes of arc. At other altitudes the beam will be elliptical, as the beam-width in declination increases with zenith angle.

The arms of the cross are about 40 meters wide, resulting in a half-power width of about [redacted] in the wide dimension of either fan beam. Two advantages accrue from such broad arms. First, the relatively narrow beams produced materially reduce the possibility of trouble from unwanted side lobes in the over-all radiation pattern of the cross. Second, the total collecting area of the antenna is large, so the telescope has great sensitivity. The east-west arms, however, must be steerable in declination, adding greatly to the cost of the structure.

25X1D

This east-west array consists of 37 steel towers, each slightly higher than 65 feet and surmounted by a parabolic truss in the north-south vertical plane. Each truss can be tilted in declination to point from the north pole to the southern horizon by a gear of approximately [redacted] 25X1D driven by a pinion and an induction motor. All 37 motors are synchronized by means of a start-stop servomechanism. The reflecting screen consists of a large number of parallel wires stretched from east to west along the row of trusses; thus, the entire antenna is east-west polarized.

The antenna array at the focus is to consist of a row of folded cage-dipoles of broad band-width and of input impedance about 600 ohms, with a flat, reflecting grid of wires suspended above them. There will be eight dipoles in each of the 36 bays of the east-west arm, a total of 288, with an average spacing between centers [redacted] This 25X1D would appear to set the upper frequency limit of the radio telescope at about [redacted] per second, above which "grating side lobes" 25X1D would become a serious problem. The transmission-line system will be of the "branching" or "corporate structure" type, in which the transmission-line distance from each dipole to the receiver is the same.

Beneath each tower is a roomy, subterranean, concrete chamber for housing preamplifiers and to serve as a junction and phase-adjustment point for the transmission lines. At the center of the cross is another instrument chamber, perhaps 30 by 50 feet in size, the main junction point for both arms.

Simpler construction was possible for the north-south arm, which need not be mechanically steerable. It consists of a parabolic-cylindrical screen of wires, polarized in the east-west direction in order to be consistent with the other arm, and suspended on an array of steel posts. The dimensions of the reflecting screen are also the same, but as the vertex of the parabola is nearly at ground level the phase center of the north-south arm is approximately 65 feet below that of the east-west arm. This will produce a complication not experienced with smaller crosses: It will be necessary to introduce a phase delay into the signal from the north-south arm, its value depending on the zenith distance.

[redacted] 25X1D

25X1D

Approved For Release 2004/05/12 : CIA-RDP78B04560A000100010009-5

REFERENCES

PHOTOGRAPHY

[redacted] 25X1D

DOCUMENTS

1. CIA. PIC/JR-1010/61, Antimissile Complex, Sary Shagan, USSR, Apr 61 (S/[redacted] 25X1
[redacted] 25X1

2. Swenson, G.W., Jr., and Bracewell, R.N., "Some Russian Radio Telescopes," Sky and Telescope, Vol XXII, No 2, Aug 61, pp 78 & 79 (U)